
Space Weather Technical Forecast

Issued on Sunday, 12 March 2023 at 12:28 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales <https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales>

Space Weather Forecast Headline: Slight Chance of isolated M-class flares (R1-R2/Minor-Moderate radio blackouts) throughout.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low over the last 24 hours with occasional C-class activity. The largest flare a C3.2 at 12/0719UTC from AR3253, located in the southeast quadrant. There are currently 11 numbered sunspots on the visible disc. AR3245 (Cho/Beta) located in the southwest quadrant is the largest, but with little overall change in the past 24 hours apart from further decay in its small trailer spots. The remaining regions are generally small, magnetically simple, and either stable or slowly evolving.

A filament eruption was observed lifting off the southwest quadrant at 11/1630 UTC, which produced a CME (coronal mass ejection). This has been modelled as off the Sun-Earth line, so no impacts are expected. A further prominence eruption from the northeast limb was observed beginning around 12/0300UTC with an associated CME. This has also been modelled and is directed well behind the Earth orbit, so again no impacts are expected.

Solar Wind / Geomagnetic Activity: The solar wind has gradually declined from 450km/s to 380km/s. Density was mostly below average, but has risen to moderate at times in the past few hours, peak 15ppcc. Total magnetic field strength was predominantly weak but with a slight moderate period between 12/0600-0900UTC, around 9nT. The north-south component varied weakly between negative and positive levels, but with a period of more sustained negative/southward orientation between 12/0600-0900UTC, peak -8nT. Phi angle was predominantly negative (towards the Sun). Geomagnetic activity was Quiet to Unsettled (Kp 0-3).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured at GOES16 remained at background levels. High energy electron flux (greater than 2MeV) has been at moderate levels, with a peak of 956pfu at 11/2010 UTC. Electron fluence has remained below Active levels, and on a relatively flat trend. A reading of 2.07e7 was observed at 12/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to remain generally Low with occasional C-class flares, and a slight chance of an isolated M-class flare.

Solar Wind / Geomagnetic Activity: A coronal mass ejection (CME) associated with a filament eruption off the southwest quadrant on the 10th may pass close enough to Earth to give some glancing influence on Day 4 (15th), but this is low confidence. Another filament eruption observed lifting off the southwest quadrant at 11/1630 UTC, and a prominence eruption from the northeast limb beginning around 12/0300UTC both also produced CMEs. However, modelling indicates both CMEs are directed well away from Earth.

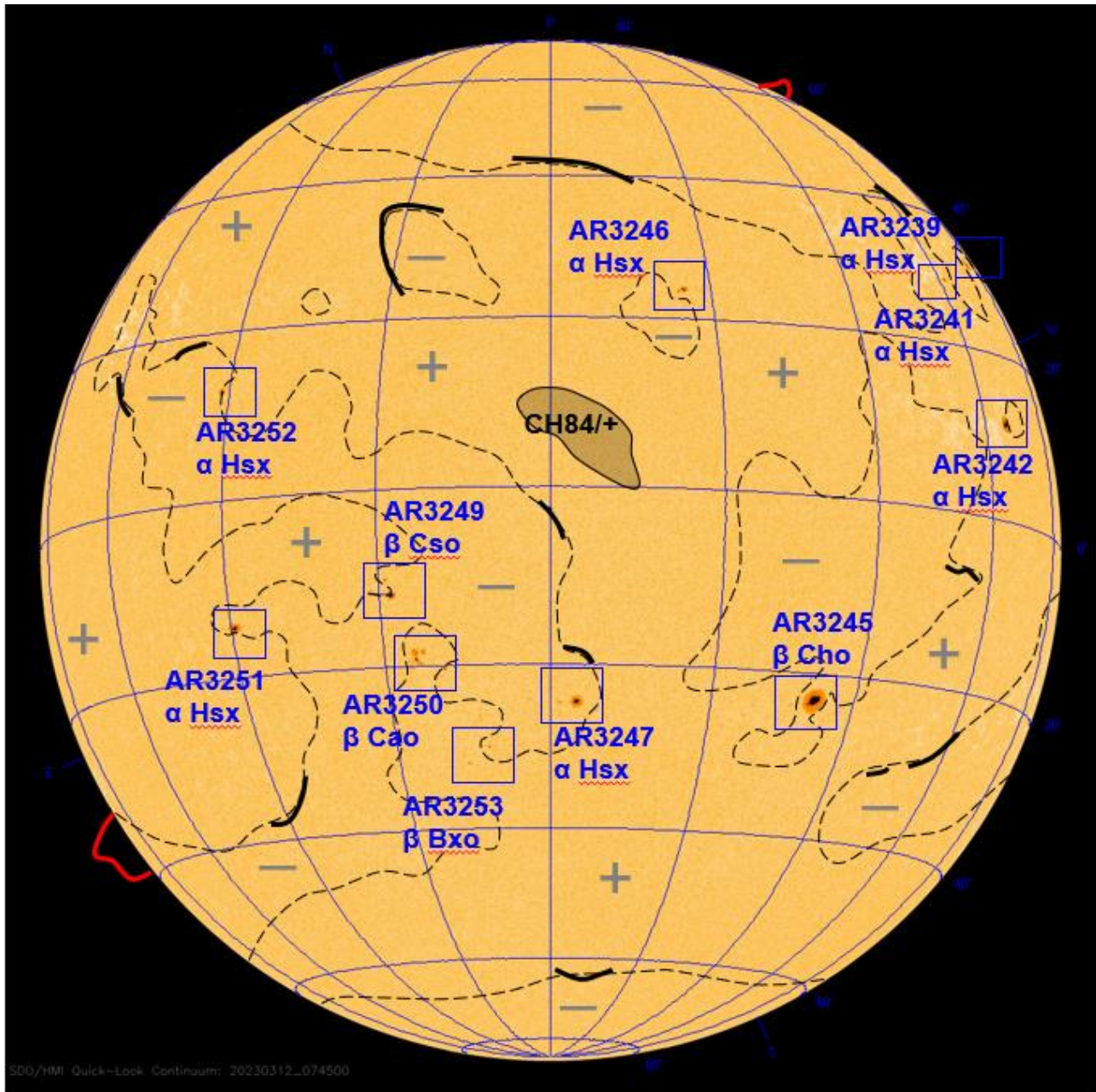
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Solar winds are now at slow-ambient levels. No further significant enhancements are expected until the next coronal hole CH84/+ becomes geo-effective. This is likely by day 4 (15 March) with winds increasing to around 500km/s.

Geomagnetic activity is likely to be mostly Quiet to Unsettled (Kp 0-3) throughout the period, with a chance of Active intervals by Day 4 (15th), either from any glancing CME effects, or the next HSS.

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux, as observed by GOES16, is currently at background levels with just a small chance of reaching the S1/Minor Storm threshold or greater should any larger flares occur. High energy electron flux levels (greater than 2MeV) are expected to oscillate predominantly between moderate and background levels. Electron fluence is expected to continue to slowly decline and remain below the Active threshold.

Figure 1. Solar Analysis Valid 12/0800UTC.



Key: Filament ____, Prominence ____, Magnetic Field Line - - -, Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Geomagnetic Storms:

A coronal mass ejection (CME) associated with a filament eruption off the southwest quadrant on the 10th may pass close enough to Earth to give some glancing influence on Day 4 (15th), but this is low confidence. Another large filament eruption was observed lifting off the southwest quadrant at 11/1630 UTC, which produced a CME. This has been modelled as off the Sun-Earth line, so no impacts are expected. A further prominence eruption from the northeast limb was observed beginning around 12/0300UTC with an associated CME. This has also been modelled and is directed well behind the Earth orbit, so again no impacts are expected.

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Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	1	1	5	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
11/0308UTC	Partial	Filament	SW	410	Not expected	Although expected miss, small chance of a passing glance on 15 th .

Radio Blackouts - X-Ray Flares:

There are currently 11 numbered sunspots on the visible disc. AR3245 (Cho/Beta) located in the southwest quadrant is the largest, but with little overall change in the past 24 hours apart from further decay in its small trailer spots. The remaining regions are generally small, magnetically simple, and either stable or slowly evolving. Some plage areas are visible toward the eastern limb but STEREO-A imagery and far side data shows only limited potential oncoming activity in the next few days.

Solar activity is expected to remain Low with occasional C-class flares. However, with the number of spot groups on the visible disc there remains a slight chance of an isolated M-class flare.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	20	20	20	20
Very Active	R3 to R5 X Class	No	1	1	1	1

Solar Radiation Storms - (High Energy Protons):

High energy (greater than 10MeV) proton flux, as observed by GOES16, is currently at background levels. Despite the number of sunspots the risk of solar radiation storms is maintained at a low level as spot groups are relatively small and magnetically simple, with flare activity currently at low levels.

Radiation Storms	Level (cm ⁻² sr ⁻¹ s ⁻¹)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	5	5	5	5
Very Active	≥ S3 *	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = cm⁻²sr⁻¹s⁻¹)

High Energy Electrons Event ($\geq 2\text{MeV}$):

High energy electron flux (greater than 2MeV) has been at background to moderate levels through the past 24 hours. Electron flux is expected to continue to follow a slow declining trend until after the next CH HSS becomes established, but this is likely to be beyond the current period. The BAS radiation belt model is suggesting high electron populations in lower Earth orbits, but there appears to be limited mechanisms for the electrons to reach higher orbits.

Electron fluence remains below the Active threshold on a relatively flat trend. Levels will probably continue to follow a steady or gradual declining trend through the period, with no inputs or enhancements into the belts until after the next CH HSS becomes connected. The output from Met Office REFM is considered to be giving a good guide, and probabilities for reaching Active fluence are relatively low.

GEO Electron Environment	Level ($\text{cm}^{-2} \text{sr}^{-1} \text{day}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^8$	No	1	1	1	10
Very Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^9$	No	1	1	1	1

Figure 2: MOSWOC REFM latest.

